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A REVIEW OF THE FISHES OF THE AGONID
GENUS *XENERETMUS* GILBERT

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ABSTRACT: The agonid genus *Xeneretmus* is reviewed and found to be composed of two subgenera: *Xenopyxis*, containing *X. latifrons*, *X. leiops*, and *X. ritteri*; and *Xeneretmus*, containing only *X. triacanthus*. The osteology of the type species of the genus, *X. triacanthus*, is described, illustrated, and compared with the other members of the genus, as well as to members of the agonid genera *Agonus*, *Hypsagonus*, and *Podothecus*. On the basis of a comparison with 15 other agonid taxa, the subgenera *Xeneretmus* and *Xenopyxis* are demonstrated to be monophyletic. A key is provided, along with synonymies, diagnoses, and descriptions for the genus, the subgenera, and species. Lectotypes are designated for *X. triacanthus* and *X. latifrons*.

INTRODUCTION

The family Agonidae is composed of typically small, benthic, scorpaeniform fishes that are almost totally encased in rows of overlapping dermal plates; the centers of these plates often bear spines or protuberances. The majority of the species are found in the North Pacific Ocean and Bering Sea; only 3 of the approximately 50 recognized species (distributed among some 20 currently recognized genera) are restricted to other regions: two in the North Atlantic Ocean (*Aspidophoroides monopterygius* and *Agonus cataphractus*), and one off southern South America (*Agonopsis chilensis*).

Only two major reviews of the family have been written. The first is that of Jordan and Evermann (1898). While this work was primarily concerned with American species, all known agonids were considered; little osteology was discussed, and only a very few specimens of each species were examined. The second review of the family is that of Freeman (1951), a widely known, but unpublished doctoral dissertation written at

Stanford University. Once again, little osteology was examined, and few specimens were used. Only two notable osteological investigations of agonids have been published: Rendahl's (1934) work on *Hypsagonus quadricornis* and Ilna's (1978) work on the genera *Podothecus* and *Agonus*. Both were limited to aspects of cranial osteology.

The taxonomic history of the genus *Xeneretmus* began with Gilbert's (1890) erection of *Xenochirus*, established to contain three species: *X. triacanthus*, *X. pentacanthus*, and *X. latifrons*. Five years later, Gilbert (1895) described a fourth species, *Xenochirus alascanus*. In 1903 Gilbert (in Jordan 1903) became aware of the prior use of the name *Xenochirus* by Gloger (1842) for a genus of marsupial mammals, and therefore offered *Xeneretmus* as a replacement name. In the following year, a fifth member of the genus, *X. infraspinatus*, was described by Gilbert (1904). In his final paper on this genus, Gilbert (1915) described two additional species, *X. ritteri* and *X. leiops*, moved *X. alascanus*, *X. infraspinatus*,

and *X. pentacanthus* into a new genus, *Asterotheca*, and created two subgenera within *Xeneretmus*: *Xenopyxis* containing *X. latifrons*, *X. leiops*, and *X. ritteri*; and *Xeneretmus* containing only *X. triacanthus*. Jordan et al. (1930), without explanation, raised the subgenus *Xenopyxis* to generic status. Although a few later workers (Barnhart 1936; Clemens and Wilby 1961) followed Jordan et al. (1930), the majority of recent workers (Freeman 1951; Peden and Gruchy 1971; Miller and Lea 1972; Hart 1973; Barraclough and Peden 1976; Robins 1980; Eschmeyer et al. 1983) retained Gilbert's (1915) classification.

Since Gilbert (1915), only minor publications on the genus have appeared. Bolin (1937), while noting that Gilbert's (1915) labels on the illustrations of *X. ritteri* and *X. leiops* were switched, extended the geographic range of *X. leiops* north from Santa Catalina Island to Monterey Bay. Peden and Gruchy (1971) expanded the range of *X. triacanthus* into British Columbian waters. Ginn and Bond (1973) extended the range of *X. leiops* north to the Columbia River. Three years later, Barraclough and Peden (1976) extended the range of *X. leiops* further north to southern British Columbia and noted, as did Bolin (1937), the switching of Gilbert's (1915) labels.

The purposes of this study are to provide a complete osteological description of the genus *Xeneretmus*, to describe variation in a number of systematically important characters, to designate type material for the species where it is in question, and to investigate the phyletic nature of the genus, subgenera, and closely related taxa.

MATERIALS AND METHODS

All measurements were taken from the right side of the fish. Standard length (SL), used throughout, was measured from the tip of the snout to the posteroventral corner of the last supralateral plate. Other measurements were made as follows:

- Anal, first dorsal, and second dorsal lengths.—from the tip of the snout to the insertion of the first ray of the respective fin
- Caudal peduncle length.—from the insertion of the posteriormost anal ray to the posteroventral corner of the last supralateral plate
- Vent length.—from the tip of the snout to the anterior margin of the anal opening
- Ventral head length.—from the tip of the snout to the posterior margin of the isthmus

Depth at first and second dorsal.—the shortest distance from the first ray of that fin to the ventral contour of the body

Head length.—from the tip of the snout to the posteriormost margin of the opercular membrane

Supraoccipital pore to snout.—from the tip of the snout to the anterior edge of the acousticolateralis pore located dorsal to the supraoccipital bone

Snout length.—from the tip of the snout to the anterior margin of the orbit

Upper jaw length.—from the anteriormost extent of the premaxilla to the posteriormost margin of the maxilla

Length of orbit.—greatest distance between the rims of the orbit

Interorbital width.—least distance between the lateral margins of the frontals

Length of pectoral and pelvic fins.—from the base of the longest ray to its tip

Caudal depth.—least depth of the caudal peduncle

Pectoral width.—the greatest width measured between the pectoral bases

Ural centra are included in vertebral counts obtained from radiographs.

Nomenclature for, and the method of enumeration of, dermal plates follow the system outlined by Gruchy (1969) with the following additions: the number of plates anterior or posterior to a fin is counted to or from, but not including, the plate on which the first or last ray of the fin is inserted; the ventrolateral series of plates is considered to start at the pelvic fin base.

Cladistic analysis was performed using Joseph Felsenstein's (Department of Genetics, University of Washington) Package for Inferring Phylogenies. Summary statistics were calculated using SPSS and SCSS (Nie et al. 1975, 1980). All programs were run on a Digital Electronics Corporation VAX, under the VMS operating system.

For the phylogenetic analysis, characters from the following in-group were recorded: *Aspidophoroides bartoni*, *A. olriki*, *Bathyagonus alascanus*, *B. infraspinnatus*, *B. nigripinnis*, *B. pentacanthus*, *Bothragonus swani*, *Odontopyxis trispinosa*, *Xeneretmus latifrons*, *X. leiops*, *X. ritteri*, and *X. triacanthus*. A close relationship of these taxa was hypothesized by Freeman (1951); all are members of his subfamily Xeneretminae. A set of morphological characters (Table 1) was

TABLE 1. DISTRIBUTION OF CHARACTERS FROM SELECTED AGONID TAXA.

Species	Circum- orbital 1 spine	Circum- orbital 3 spines	Pterotic spines	Posttem- poral spines	Parietal spines	Frontal spines	Nasal spines	Exposed supra- ethmoid spines	Pre- opercu- lar spines	Free-fold of isthmus	Maxillary barbels	Exposed rostral plate	Rostral plate spines	Dermal body plate spines	Breast plates about cheek	Arrange- ment of ventral pectoral rays	Develop- ment of thick- ened fingerlike projec- tion of
<i>Aspidophoroides</i>																	
<i>bartoni</i>	absent	absent	absent	absent	absent	absent	one	absent	absent	present	one	present	none	absent	yes	tight	no
<i>Aspidophoroides</i>																	
<i>atraki</i>	absent	absent	absent	absent	absent	absent	one	absent	absent	present	one	present	none	absent	yes	loose	no
<i>Bathyanthus</i>																	
<i>alascamus</i>	present	present	absent	present	present	present	one	absent	two	absent	two	present	five	present	yes	tight	much
<i>Bathyanthus</i>																	
<i>infrastrimatus</i>	present	present	absent	present	present	present	one	absent	two	present	two	present	five	present	yes	tight	much
<i>Bathyanthus</i>																	
<i>nigriripis</i>	absent	present	present	present	present	present	one	absent	two	absent	two	present	five	present	yes	loose	no
<i>Bathyanthus</i>																	
<i>penicacanthus</i>	present	present	present	present	present	present	one	absent	two	absent	two	present	five	present	yes	loose	much
<i>Bathyanthus</i>																	
<i>swani</i>	absent	absent	absent	absent	absent	absent	one	absent	absent	absent	one	present	none	absent	yes	tight	much
<i>Odontopyxus</i>																	
<i>trispinosa</i>	present	absent	absent	absent	absent	absent	one	absent	absent	absent	one	present	one	present	yes	tight	slight
<i>Xeneretmus</i>																	
<i>latifrons</i>	absent	present	absent	present	present	present	one	absent	one	present	one	present	one	present	no	absent	much
<i>Xeneretmus</i>																	
<i>leicops</i>	absent	present	absent	present	present	present	one	absent	one	present	one	present	1-3	present	no	absent	much
<i>Xeneretmus</i>																	
<i>ritteri</i>	absent	present	present	present	present	present	one	absent	one	present	two	present	one	present	no	absent	much
<i>Xeneretmus</i>																	
<i>tracanthus</i>	absent	present	absent	present	present	present	one	absent	two	absent	two	present	three	present	yes	loose	much
<i>Agonopsis vulsa</i>	present	present	present	present	present	present	two	present	two	present	three	absent	none	present	yes	loose	much
<i>Hypsogonus</i>																	
<i>quadricornus</i>	absent	present	absent	absent	present	present	one	absent	two	present	one	absent	none	present	no	absent	much
<i>Ocella</i>																	
<i>dodecaedron</i>	absent	absent	absent	absent	absent	absent	one	absent	two	present	two	absent	none	present	yes	absent	no
<i>Pallasina</i>																	
<i>barbata</i>	absent	absent	absent	absent	absent	absent	one	absent	two	present	none	absent	none	absent	yes	loose	no
<i>Percis japonicus</i>	present	present	absent	absent	absent	present	one	absent	two	present	one	absent	none	present	no	absent	slight
<i>Podothecus</i>																	
<i>acpenserinus</i>	present	present	present	present	present	present	two	present	one	absent	≥ 10	absent	none	present	yes	absent	slight
<i>Sarritor frenatus</i>	present	present	absent	present	present	present	two	present	two	present	four	absent	none	present	yes	loose	slight

collected and converted to binary characters (Table 2) by additive binary coding (Sokal and Sneath 1963; Kluge and Farris 1969). The ancestral state of each binary character was established by examining an out-group, that is, a group of taxa considered not to be members of the smallest monophyletic unit that contains all members of the in-group. The most frequent character state found among the species of the out-group was considered to be the primitive character state for the taxa of the in-group. The out-group was composed of *Agonopsis vulsa*, *Hypsagonus quadricornis*, *Ocella dodecadron*, *Pallasina barbata*, *Percis japonicus*, *Podotheus acipenserinus*, and *Sarritor frenatus*, seven agonid species considered to be related to but not members of the in-group (Jordan and Evermann 1898; Freeman 1951).

Several methods of estimating phylogenies from binary data have been proposed (Felsenstein 1982, and references cited therein). Of these methods, Wagner analysis (Farris 1970; Farris et al. 1970a, 1970b) has been the most widely employed (Baird and Eckhardt 1972; Simon 1979; Presch 1980; Jensen and Barbour 1981; Miyamoto 1983) and has been examined in detail (Colless 1981; Felsenstein, 1973, 1978, 1979; Mickevich 1978, 1980, Mickevich and Farris 1981; Schuh and Farris 1981; Schuh and Polhemus 1980; Sokal and Rohlf 1981). Felsenstein (1973, 1978, 1979) has shown some assumptions of the method:

1. Characters evolved independently.
2. Changes of character states through time are a priori improbable.
3. Polymorphisms of character states for a species are exceedingly unlikely.
4. Inequality of lengths of segments of the tree is not so extreme that two changes of states along a long segment is more probable than one change along a short segment.
5. Different lineages evolved independently.

While these assumptions do not exactly express how the world is believed to work, without assumptions no explicit model could be advanced; with them at least we know the assumptions upon which the hypothesis rests. All systematists make assumptions when trying to work out a phylogeny, but their assumptions are not as open to examination as are those of a model. The Wagner method searches for the cladogram that requires

the fewest number of steps for all the characters. Some hypothesized monophyletic sets may not be supported by uniquely derived characters.

Osteological material was cleared and stained with alizarin red S following the method of Taylor (1967). Osteological drawings were prepared with the aid of a Wild M5 stereomicroscope and camera lucida. Osteological terminology follows Weitzman (1974).

The following cleared and stained specimens were examined: *Xeneretmus latifrons*: UW 18216, 3 (148–171 mm); *X. leiops*: OSU 7309, 2 (186, 191 mm); *X. ritteri*: SIO 59-92, 1 (141 mm); *X. triacanthus*: UW 20948, 3 (146–167 mm).

The following abbreviations are used in the osteological illustrations:

ANG	angular	MSP	mesopterygoid
ARP	articular process	MTP	metapterygoid
ASP	ascending process	MVP	mid-ventral plate
BPT	basipterygium	N	nasal
BR	branchiostegal ray	NZ	neural zygapophysis
BSB	basibranchial	OP	opercle
BSO	basioccipital	PC	postcleithrum
CBR	ceratobranchial	PHY	parahypural
CHY	ceratohyal	PLT	palatine
CL	cleithrum	PM	premaxilla
CO	circumorbital	POP	preopercle
COR	coracoid	PPH	paraphophysis
DH	dorsal hypohyal	PRO	prototic
DLP	dorsolateral plate	PRT	parietal
DN	dentary	PSP	parasphenoid
ECT	ectopterygoid	PTG	pterygiophore
EPB	epibranchial	PTO	ptericotic
EPH	epiphyal	PTS	pterosphenoid
EPO	epiotic	PTT	posttemporal
EPU	epural	Q	quadrate
ER	epiplural rib	R	radial
EXO	exoccipital	RAT	retroarticular
F	frontal	RP	rostral plate
FHA	first haemal arch	SBO	subopercle
HPP	hypural plate	SCL	supracleithrum
HYB	hypobranchial	SCP	scapula
HYM	hyomandibular	SET	supraethmoid
IHY	interhyal	SLP	supralateral plate
ILP	infralateral plate	SOC	supraoccipital
INT	intercalar	SPH	sphenotic
IOP	interopercle	SPN	spine
IPB	infrapharyngo branchial	SYM	symplectic
LC	lacrimal	T	tabular
LE	lateral ethmoid	UC	ural centrum
LLS	lateral-line scale	URN	uroneural
M	maxilla	V	vomer
MDP	mid-dorsal plate	VH	ventral hypohyal
MIS	medial interopercular socket	VLP	ventrolateral plate

Material examined is deposited at the following institutions: California Academy of Sciences,

San Francisco (CAS); Natural History Museum of Los Angeles County (LACM); Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (MCZ); National Museum of Canada, Ottawa (NMC); Oregon State University, Corvallis (OSU); Scripps Institution of Oceanography, La Jolla, California (SIO); Stanford University (SU), material now housed at CAS; University of Alberta, Museum of Zoology, Edmonton, Alberta (UAMZ); United States National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM); and School of Fisheries, University of Washington, Seattle (UW).

COMPARATIVE MATERIAL EXAMINED

Agonopsis vulsa: UW 4798 (27), UW 5359 (40).

Aspidophoroides bartoni: CAS 10842 (2), CAS 15508 (1), CAS 15509 (1), CAS 22355 (2), CAS 26764 (3), CAS 26773 (1), MCZ 28323 (1), MCZ 32463 (1), SU 20421 (1), SU 26136 (5), SU 31699 (3), USNM 125584 (5), USNM 149047 (7), UW 20940 (1), UW 20941 (1), UW 20942 (1), UW 20943 (1), UW 20944 (4), UW 20945 (2), UW 20946 (2), UW 20947 (3).

Aspidophoroides olrki: NMC 77-1537 (26), USNM 177610 (1), UW 20935 (3), UW 20936 (2), UW 20937 (1), UW 20938 (2).

Bathygonus alascanus: NMC 650219 (3), NMC 65-319 (3), NMC 66-16 (1), SIO 69-138 (3), SU 3088 (13), UAMZ 1985 (5), UAMZ 2774 (4), USNM 48741 (1), USNM 53582 (1), USNM 53583 (3), USNM 53586 (2), USNM 53589 (5), USNM 53592 (1), USNM 60484 (1), USNM 208391 (2), UW 1422 (5), UW 14392 (11).

Bathygonus infraspinitus: CAS 14911 (2), NMC 65-259 (1), SIO 63-203 (2), SIO 69-110 (2), SIO 72-230 (1), SIO 72-239 (1), SU 24967 (3), USNM 53593 (1), USNM 53595 (4), USNM 53596 (1), USNM 53597 (2), USNM 53598 (1), USNM 60416 (1), USNM 104676 (15), USNM 207968 (1), USNM 207990 (1), USNM 208117 (1), UW 1660 (1), UW 2886 (5), UW 5006 (1), UW 7583 (1).

Bathygonus nigripinnis: CAS 45524 (1), CAS 45525 (1), CAS 45526 (1), SIO 63-205 (8), SIO 69-140 (3), USNM 46613 (3), UW 7333 (4), UW 18147 (8), UW 20931 (1), UW 20932 (7), UW 20933 (1).

Bathygonus pentacanthus: CAS 15130 (4), NMC 65-397 (1), NMC 65-423 (6), NMC 71-693 (1), SIO 75-355 (3), SIO 80-9 (1), USNM 46612 (3), USNM 63444 (1), UW 18145 (15), UW 18472 (6), UW 19140 (3), UW 20934 (1).

Bothragonus swani: UW 14155 (2), UW 17971 (1), UW 20929 (1), UW 20930 (2).

Hypsigonus quadricornis: UW 11721 (32).

Ocella dodecaedron: UW 20999 (5).

Odontopyxis trispinosa: UW 1752 (4), UW 4375 (5).

Pallasina barbata: UW 4206 (3).

Percis japonicus: UW 21000 (1), UW 21001 (1).

Podothecus acipenserinus: UW 3977 (125), UW 7340 (12).

Sarritor frenatus: UW 20998 (5).

OSTEOLOGY OF *XENERETMUS TRIACANTHUS*

CRANIUM (Figs. 1, 9).—Rostral plate unpaired, situated anterodorsal to nasals, most anterior os-

teological element and bears a single, dorsally directed spine; on either side, a laterally directed spine.

Nasals in contact anteriorly, but separated posteromedially by anterior third of supraethmoid. Each, bordered laterally by respective lacrimal (Fig. 9), bears a strong, posterodorsally directed nasal spine.

Lateral ethmoids lie posterior to nasals. Each comes into contact with frontal medially, lacrimal laterally (Fig. 9), and parasphenoid ventrolaterally.

Frontals are in contact with each other on midline for most of their length, separated by supraethmoid anteriorly. Each frontal bordered posteriorly by sphenotic, pterotic, and parietal; posteroventrally by pterosphenoid. A sharp spine is present on the dorsal surface of each frontal, just posterodorsal to the orbit.

Parietals meet on dorsal midline. Bordered along lateral margin by pterotic, tabular, and posttemporal. Each bears two posterodorsally directed spines: anteriormost spine knoblike, posteriormost strong and sharp.

Most of the anterodorsal surface of supraoccipital, covered by parietals, comes into contact with exoccipitals along posterior margin. Pterotic meets sphenotic anteriorly, tabular posteriorly, and prootic, exoccipital, intercalary, and posttemporal ventrally.

Tabular dorsal to the epiotic; posttemporal bears a spine at posterior margin. Supracleithrum articulates with posteroventral surface of posttemporal.

Epiotic attaches at posterolateral corner of cranium, situated ventral to tabular and posttemporal. Exoccipital forms lateral and dorsal borders of foramen magnum; anteriorly, it forms posterolateral portion of otic capsule. A condyle at its posteroventral corner contacts the lateral process of the anteriormost vertebral centrum (preural centrum 41).

Basioccipital, broad anteriorly, narrowing posteriorly, forms ventral margin of foramen magnum. A single large condyle situated posteriorly, abuts against the anteriormost vertebral centrum. A posterior projection of parasphenoid overlaps anterior midline of basioccipital ventrally; its anterolateral corner forms postero-medial portion of otic capsule.

Parasphenoid runs from vomer anteriorly to basioccipital posteriorly, forms ventral margin of cranium; anteriorly receives shaft of vomer.

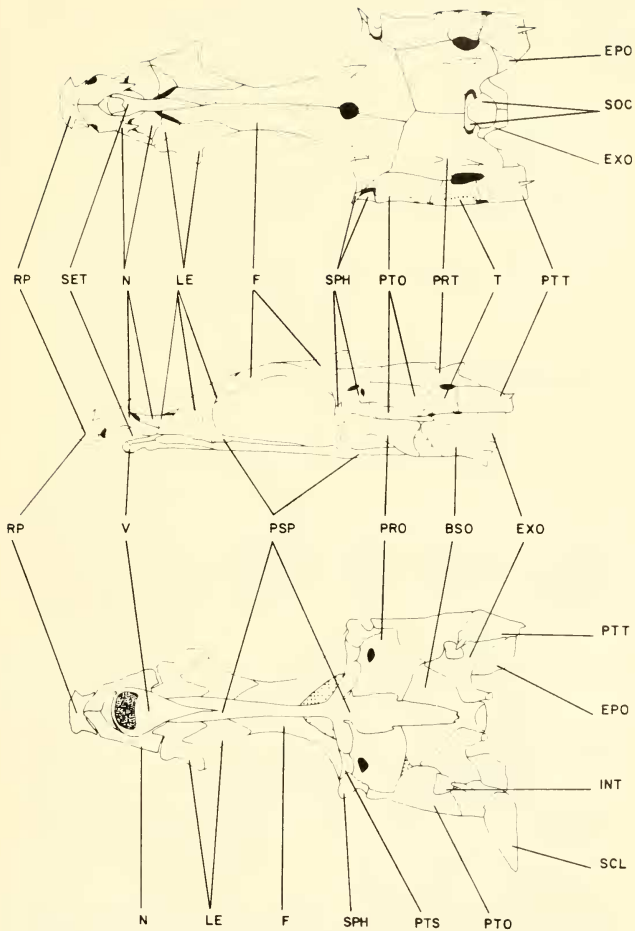


FIGURE 1. Dorsal, left lateral, and ventral views of cranium of *Xeneretmus triacanthus*, UW 20948, 158 mm SL. Dotted lines portray canals of the acoustico-lateralis system.

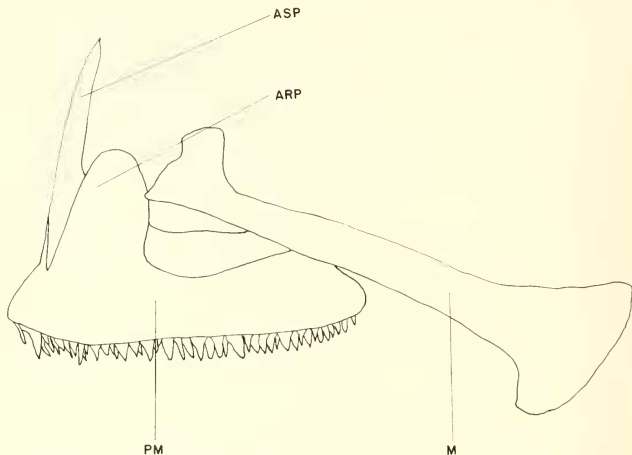


FIGURE 2. Left lateral view of upper jaw of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

Lateral ethmoids border on its anterolateral surface and its dorsolateral projections abut on pterosphenoids dorsally and form posterior margin of orbits. Vomer is "tear"-shaped; teeth borne

along its anteroventral surface arranged in semi-circular pattern.

Prootic forms anterior portion of otic capsule; does not reach posterior margin of orbit.



FIGURE 3. Left lateral view of lower jaw of *Xeneretmus triacanthus*, UW 20948, 158 mm SL. Dotted lines portray acoustico-lateralis canals.

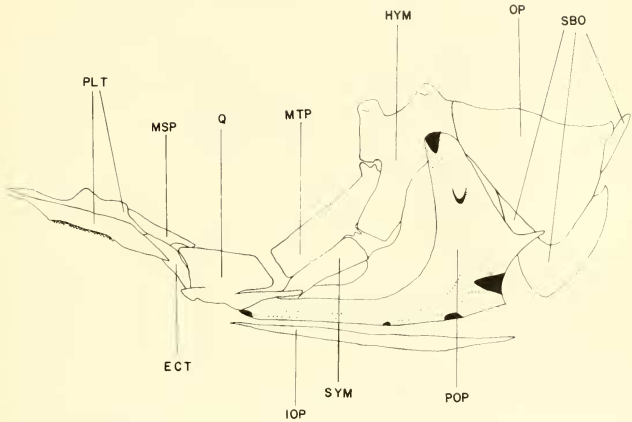


FIGURE 4. Lateral view of suspensorium and opercular apparatus of *Xeneretmus triacanthus*, UW 20948, 158 mm SL, right side reversed. Dotted lines portray acoustic-lateralis canals.

Intercalar approximately circular; dorsally bordered by exoccipital and pterotic. Antero-medially directed projection of posttemporal overlies its posteroventral face.

UPPER JAW (Fig. 2).—Premaxilla toothed along

entire ventral surface in a broad band. The maxilla forked anteriorly to receive ascending process of premaxilla and widens abruptly posteriorly.

LOWER JAW (Figs. 3, 4).—Anterodorsal three-fourths of dentary toothed. Angular bears socket

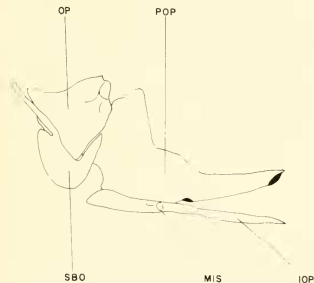


FIGURE 5. Left medial view of opercular apparatus of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

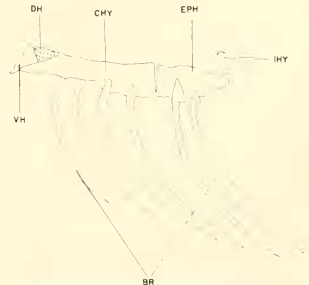


FIGURE 6. Left lateral view of hyoid apparatus of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

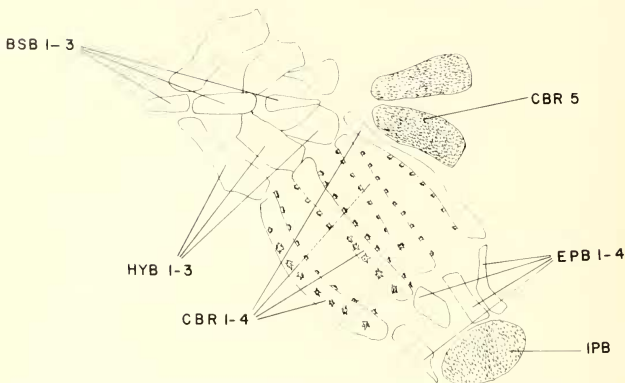


FIGURE 7. Dorsal view of branchial basket of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

on posteromedial surface to receive a process of quadrate (Fig. 4). Retroarticular attaches to the posteroventral corner of angular.

SUSPENSORIUM (Figs. 1, 4-6, 9).—Palatine toothed for a third of its length, teeth centered about midpoint. It articulates posteriorly with mesopterygoid and ectopterygoid. Anterodorsal surface of palatine articulates with ventral surface of lateral ethmoid (Fig. 1). A lateral process of palatine articulates with medial surface of lacrimal.

Mesopterygoid borders ectopterygoid ventrally, quadrate posteriorly; does not contact metapterygoid. The ectopterygoid lies between palatine, mesopterygoid, and quadrate. Posteroventral surface of quadrate contacts preopercle. Metapterygoid thin and flat; borders symplectic anteroventrally and hyomandibular posteroventrally.

Hyomandibular has three dorsal articulating facets: anteriormost, articulating with sphenotic and prootic; medial articulating with pterotic; and posteriormost articulating with anterodorsal corner of the opercle (Fig. 1).

Preopercle crescent-shaped with two spines along posterior margin. It is dorsally overlain by circumorbital 3 (Fig. 9). Elongate interopercle bears medial socket that fits onto posterior cor-

ner of epihyal (Figs. 5, 6). Opercle triangular and slightly striated; a socket on anterodorsomedial face receives posterior facet of hyomandibular. Subopercle V-shaped, with crotch of the V lying dorsal to opercle (Fig. 5); posterior arm long and thin, lying on medial face of opercle for majority of its length; anterior arm short, its most dorsal point reaching only half the height of opercle.

HYOID ARCH (Figs. 5, 6).—Dorsal hypophyal anterodorsal to ceratohyal. Ventral hypophyal forms an anterior cap over ceratohyal. Ceratohyal has four branchiostegal rays connected to it: anterior two ventrally attached, posterior two ventrolaterally. Epihyal connected to the remaining two basibranchials ventrolaterally. Posterodorsally, interhyal connects epihyal to hyomandibular. Posterior corner of epihyal fits into medial socket of interopercle (Fig. 5).

BRANCHIAL ARCHES (Fig. 7).—Hypobranchials 1-3 broad and flat. Hypobranchial 2 two-thirds length of hypobranchial 1; hypobranchial 3 tear-shaped and two-thirds length of hypobranchial 2. All four ceratobranchials have anterior rows of gillrakers that bear toothlike structures; ceratobranchials 1-3 also possess posterior rows of similar, "tooth"-bearing gillrakers. Ceratobranchials 3 and 4 articulate with hypobranchial 3. Ceratobranchial 5 oval, completely toothed. Epi-



FIGURE 8. Dorsal view of urohyal of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

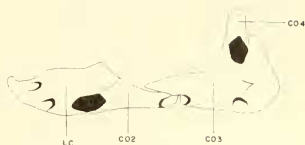


FIGURE 9. Left lateral view of circumorbital bones of *Xeneretmus triacanthus*, UW 20948, 158 mm SL. Dotted lines portray acoustic-lateralis canals.

branchials 1-4 all articulate dorsally with a single, large, well-toothed infrapharyngobranchial. Epibranchial 1 forked dorsally in some specimens.

UROHYAL (Fig. 8).—Urohyal triangular, with a dorsomedial ridge rising posteriorly.

CIRCUMORBITAL SERIES (Figs. 1, 9).—Lacrimal forms majority of dorsal surface area of snout and connects with lateral ethmoid and nasal (Fig. 1). Circumorbital 2 is tubelike. Circumorbital 3 has a single centrally located and posteriorly directed spine on lateral surface. Circumorbital 4 also tubelike, forming posterior margin of orbit.

PECTORAL GIRDLE (Fig. 10).—Three rectangular radials and two postcleithra present. Scapula crescent-shaped and attached to posterior margin of cleithrum by two arms. Coracoid L-shaped, its anterior arm in contact medially with ventrolateral face of cleithrum; the dorsal arm with ventral margin of scapula and anterior borders of two ventralmost radials. Cleithrum the largest element of pectoral girdle; dorsally attaches to supracleithrum.

PELVIC GIRDLE (Fig. 11).—Basipterygia paired and connected medially to each other along posterior tenth of their length. A ventral ridge runs anteroposteriorly. One spine and two rays present; lateralmost ray tightly bound to medial surface of spine.

VERTEBRAL COLUMN (Fig. 12).—There are 41 preural centra in all the specimens of *Xeneretmus triacanthus* dissected. The 41st preural centrum has three anterior concave facets (a large central facet and two smaller lateral ones) that articulate with posterior surface of cranium; neuropophyses not dorsally ankylosed; 41st through 31st preural centra bear epiplural ribs. Neural zygapophyses become more pronounced posteriorly. Haemal spines on 29th through first preural

centra. Haemal spines posterior to posteriormost anal fin pterygiophore lie ventral to adjacent posterior centrum (this tendency increases posteriorly).

Posterior two rays of anal and second dorsal fin articulate with last pterygiophore of ventral and dorsal series, respectively. Four pterygiophores lie between first and second dorsal fins. No ray articulates with these pterygiophores. Anterior two pterygiophores of ventral series do not articulate with any rays.

Neural spines on 40th through first preural centra; centra posterior to last dorsal pterygiophore have broad neural spines that lie between neural zygapophyses of adjacent posterior ural centrum.

One parahypural fused to ventral margin of hypural plate. One uroneural tightly bound to dorsal margin of hypural plate. Epurals absent.

DERMAL PLATES (Fig. 13).—All dermal plates of supralateral, dorsolateral, and mid-dorsal series bear posteriorly directed spines. All infralateral plates bear similar spines as well, except those medial to pectoral fin. Ventrolateral plates spineless, except for those behind pelvic fin insertion to approximately four plates anterior to insertion of first anal fin ray. Mid-ventral plates spineless.

Anterior supralateral plates overlain posteriorly by next supralateral plate for approximately half their length; those more posterior in position overlain by as little as 20% of their length. Supralateral plates overlain by dorsolateral and mid-dorsal plates dorsally, and lateral-line scales ventrally.

Anterior infralateral plates have half their length overlain by adjacent posterior infralateral plate; length covered reduced to 20% posteriorly. Infralaterals overlain by lateral-line scales dor-

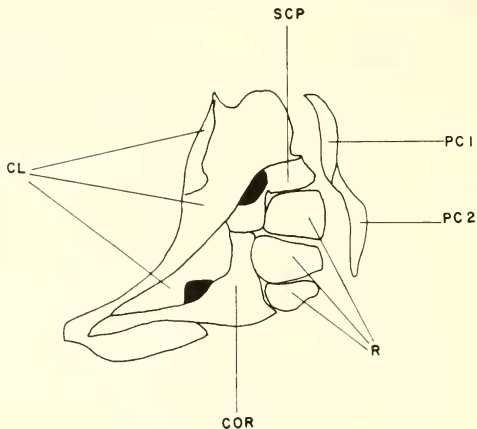


FIGURE 10. Left lateral view of pectoral girdle of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

sally and ventrolateral and mid-ventral plates ventrally.

Ventrolateral plates bordering anal fin have medial projections that meet on midline such that fin rays surrounded by plates. A third of the length of each ventrolateral plate overlain pos-

teriorly by next ventrolateral plate. Medially, ventrolateral plates slightly overlap each other on midline.

Each mid-ventral plate posteriorly overlain by immediately posterior mid-ventral plate; length covered approximately 15%.

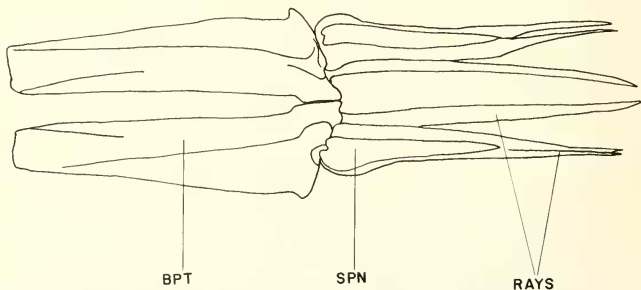


FIGURE 11. Ventral view of pelvic girdle of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

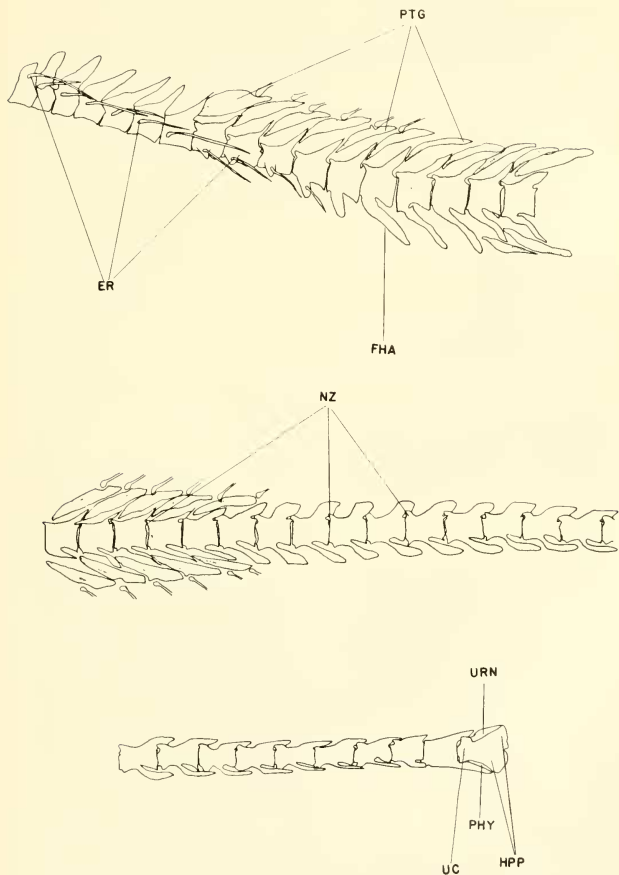


FIGURE 12. Left lateral view of vertebral centra of *Xeneretmus triacanthus*, UW 20948, 158 mm SL.

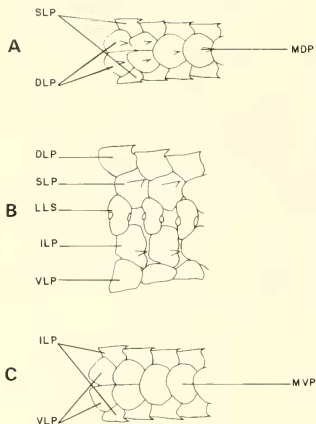


FIGURE 13. Dermal body plates of *Xeneretmus triacanthus*, UW 20948, 158 mm SL: (A) Dorsal view of plates immediately posterior to insertion of posteriormost ray of second dorsal fin. (B) Left lateral view of plates immediately posterior to pectoral fin. (C) Ventral view of plates immediately posterior to insertion of posteriormost anal fin ray.

Each dorsolateral plate overlain posteriorly by next dorsolateral plate for approximately 35% of length. Like ventrolaterals, dorsolateral plates bordering first and second dorsal fins have medial projections that meet on dorsal midline such that only a small break in plates exists where dorsal rays insert.

Each mid-dorsal plate overlain posteriorly for 20% of length by adjacent posterior mid-dorsal plate.

ACOUSTICO-LATERALIS SYSTEM (Figs. 1, 3, 4, 9).—Acoustico-lateralis system of cranium passes posteriorly through nasals. Canal enters frontals through an anterior pore and extends along medial border to a medial pore where it turns laterally, continuing to posterolateral pore of frontal where it branches (Fig. 1). Anteriorly directed branch of acoustico-lateralis system passes through entire circumorbital series (Fig. 9). Posteriorly directed branch passes through pterotic and branches again beneath tabular. Medially

directed branch passes beneath posterior spine of parietal to a medial pore dorsal to supraoccipital where it meets its counterpart from the other side. Posteriorly directed branch passes through posttemporal and supracleithrum, continues posterolaterally along entire length of fish (Fig. 1). A second acoustico-lateralis canal passes posteriorly through dentary, angular, and preopercle (Figs. 3, 4).

COMPARATIVE OSTEOLOGY

The osteology of the other species of the genus is almost identical with that of *X. triacanthus* described above; very few differences were found between species that exceeded variation within species. *Xeneretmus triacanthus* has two spines on the posterior margin of the preopercle whereas its congeners possess only one. The rostral plate of the other members of the genus do not have lateral spines (except in some individuals of *X. leiops*). *Xeneretmus ritteri* has two spines on circumorbital 3, whereas the other species of *Xeneretmus* have only one. Finally, the pterotic of *X. ritteri* bears two spines while in the other members of the genus only a ridge may be discerned.

The following comparisons can be made with Rendahl's (1934) work on the agonid species *Hypsagonus quadricornis*. The rostral plate, diagnostic for *Xeneretmus* (Fig. 1), does not occur in *Hypsagonus* (Rendahl 1934, figs. 1-3). The vomer of *Hypsagonus* is toothless (Rendahl 1934, fig. 2). The frontal spine of *Hypsagonus* is much larger than that of *Xeneretmus* (Fig. 1; Rendahl 1934, figs. 1, 3). In *Hypsagonus*, Rendahl (1934, fig. 1) depicted the supraoccipital as lying along the entire medial border of the parietal, in such a configuration that the parietals are not in contact along their medial edges; the parietals meet along their entire medial edges in *Xeneretmus* (Fig. 1). Rendahl (1934, figs. 28A, 28B) depicted the retroarticular as lying only on the medial face of the angular whereas in *Xeneretmus* the retroarticular is visible from both a medial and lateral view (Fig. 3). Rendahl (1934, fig. 24A) showed the mesopterygoid and metapterygoid of *Hypsagonus* to be in contact with each other; in *Xeneretmus* the quadrate is between these two bones such that they do not meet (Fig. 4). Finally, the posterior arm of the subopercle of *H. quadricornis* is considerably shorter than is the case for *Xeneretmus* (Figs. 4, 5; Rendahl 1934, figs. 24A, 24B).

The following comparisons can be made with the work of Iliina (1978). Neither of the genera *Podothecus* and *Agonus* possesses a rostral plate. Iliina (1978, figs. 2–4, 6) portrayed the supraoccipitals of *Podothecus acipenserinus*, *P. veternus*, *P. gilberti*, and *P. thompsoni* as lying between the parietals, such that they do not meet along their medial edges, as they do in *Xeneretmus* (Fig. 1). The posttemporal of *Podothecus acipenserinus*, *P. veternus*, and *Agonus cataphractus* apparently makes no contact with the intercalar (Iliina 1978, figs. 2, 3, 7); in *Xeneretmus* the anteriorly directed projection of the posttemporal touches the intercalar (Fig. 1).

SYSTEMATICS

Genus *Xeneretmus* Gilbert

Xenochirus GILBERT, 1890:90 (type-species *Xenochirus triacanthus* GILBERT, 1890, by original designation; preoccupied by *Xenochirus* GLOGER, 1842, a genus of marsupial mammal).

Xeneretmus GILBERT, in Jordan 1903:360 (substitute name for *Xenochirus* GILBERT, 1890 [preoccupied, therefore taking the same type-species *Xeneretmus triacanthus*]).

DIAGNOSIS.—The genus *Xeneretmus* is distinguished from all other agonid genera by the absence of a supraoccipital pit and by the presence of an exposed rostral plate bearing a single dorsally directed spine.

DESCRIPTION.—Body tapering uniformly from pectoral girdle to caudal fin; anterior cross sections octagonal, cross section through caudal peduncle hexagonal; completely encased in overlapping dermal plates. All dorsolateral, mid-dorsal, and supralateral plates bearing posteriorly directed spines; all but those plates medial to pectoral fin of infralateral series bearing posteriorly directed spines; ventrolateral plates between pelvic fin insertion and insertion of first anal fin ray bearing posteriorly directed spines; no spines present on mid-ventral plates; dorsolateral plates 22–24; mid-dorsal plates 12–19; supralateral plates 39–45; infralateral plates 35–42; ventrolateral plates 21–23; mid-ventral plates 14–20. In comparison with the other genera of Agonidae, *Xeneretmus* has long spines on slightly flexible angular dermal plates.

Cephalic spines. One nasal spine; one frontal spine dorsal to posterior edge of orbit; two parietal spines; one posttemporal spine; one or two spines on circumorbital 3; one or two spines on posterior margin of preopercle.

Fin rays. All simple; four ventralmost pectoral

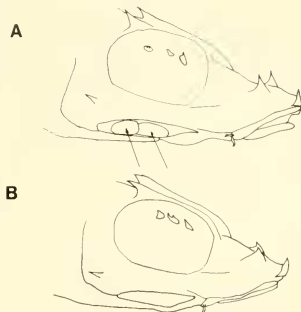


FIGURE 14. Right lateral view of head of two species of *Xeneretmus*: (A) *X. triacanthus*; (B) *X. latifrons*. Arrows indicate dermal plates of cheek region.

rays thickened (in comparison to the dorsalmost pectoral rays), and projecting fingerlike from the fin membrane; dorsal two thickened rays longest rays of pectoral fin. First dorsal, 5–8; second dorsal, 6–8; anal, 5–8; pectoral, 12–16; pelvic I, 2; branchiostegal rays, 6.

Mouth. Both jaws of equal length, mouth terminal; teeth present on premaxilla, dentary, palatine, and vomer. Barbels present along ventral margin of dentary at edges of acoustico-lateralis pores and at posterior corner of maxilla.

Measurements. The following ranges for proportions of all species of the genus are expressed in thousandths of standard length (number of specimens measured in parentheses): anal length, 305–510 (201); vent length, 210–335 (197); caudal peduncle length, 370–479 (199); second dorsal length, 443–592 (201); depth at second dorsal, 47–72 (197); first dorsal length, 258–386 (203); depth at first dorsal, 65–132 (171); pectoral length, 123–217 (189); pelvic length, 51–105 (197); pectoral width, 92–157 (189); head length, 166–241 (203); ventral head length, 80–155 (200); length from supraoccipital pore to snout, 147–189 (203).

The following proportions, associated with characteristics of the head, are expressed in thousandths of head length (number of specimens measured in parentheses): orbit length, 249–476 (207); upper jaw length, 229–363 (141); snout

TABLE 3. RANGE, MEAN, STANDARD DEVIATION, AND SAMPLE SIZE FOR MERISTIC CHARACTERS OF SPECIES OF *Xeneretmus*.

Character	<i>X. latifrons</i>		<i>X. leiops</i>		<i>X. ritteri</i>		<i>X. triacanthus</i>	
First dorsal spines	6-8	$\bar{x} = 6.9$ SD = 0.50 $n = 110$	6-7	$\bar{x} = 6.7$ SD = 0.45 $n = 30$	6-7	$\bar{x} = 6.4$ SD = 0.54 $n = 7$	5-7	$\bar{x} = 6.0$ SD = 0.28 $n = 63$
Second dorsal rays	6-8	$\bar{x} = 7.0$ SD = 0.43 $n = 110$	7-8	$\bar{x} = 7.4$ SD = 0.49 $n = 30$	6-7	$\bar{x} = 6.9$ SD = 0.38 $n = 7$	6-7	$\bar{x} = 6.6$ SD = 0.50 $n = 63$
Anal fin rays	6-8	$\bar{x} = 7.2$ SD = 0.15 $n = 110$	6-8	$\bar{x} = 6.9$ SD = 0.57 $n = 30$	6-7	$\bar{x} = 6.9$ SD = 0.38 $n = 7$	5-7	$\bar{x} = 6.1$ SD = 0.49 $n = 63$
Pectoral fin rays	13-15	$\bar{x} = 14.1$ SD = 0.40 $n = 109$	13-15	$\bar{x} = 14.0$ SD = 0.33 $n = 29$	16	$\bar{x} = 16$ SD = 0.00 $n = 7$	12-14	$\bar{x} = 13.0$ SD = 0.22 $n = 61$
Eyeball plates	3-6	$\bar{x} = 4.2$ SD = 0.62 $n = 110$	0	$\bar{x} = 0.0$ SD = 0.00 $n = 30$	3-6	$\bar{x} = 5.0$ SD = 1.0 $n = 7$	2-6	$\bar{x} = 3.9$ SD = 0.76 $n = 63$
Supralateral plates	39-42	$\bar{x} = 40.9$ SD = 0.65 $n = 109$	43-45	$\bar{x} = 43.9$ SD = 0.80 $n = 28$	40-41	$\bar{x} = 40.7$ SD = 0.49 $n = 7$	41-43	$\bar{x} = 42.0$ SD = 0.46 $n = 58$
Infralateral plates	35-40	$\bar{x} = 37.6$ SD = 0.92 $n = 108$	39-42	$\bar{x} = 40.3$ SD = 0.98 $n = 28$	36-38	$\bar{x} = 36.9$ SD = 0.69 $n = 7$	38-40	$\bar{x} = 39.0$ SD = 0.49 $n = 58$
Mid-dorsal plates	12-16	$\bar{x} = 14.7$ SD = 0.63 $n = 108$	16-19	$\bar{x} = 17.7$ SD = 0.72 $n = 29$	14-15	$\bar{x} = 14.7$ SD = 0.49 $n = 7$	15-17	$\bar{x} = 16.2$ SD = 0.54 $n = 58$
Dorsolateral plates between first and second dorsal fins	3-5	$\bar{x} = 4.1$ SD = 0.53 $n = 110$	4-5	$\bar{x} = 4.4$ SD = 0.50 $n = 30$	4-5	$\bar{x} = 4.6$ SD = 0.54 $n = 7$	4-6	$\bar{x} = 5.1$ SD = 0.33 $n = 64$
Mid-ventral plates	14-17	$\bar{x} = 15.4$ SD = 0.66 $n = 109$	16-20	$\bar{x} = 18.2$ SD = 0.83 $n = 28$	14-16	$\bar{x} = 14.9$ SD = 0.69 $n = 7$	16-18	$\bar{x} = 16.7$ SD = 0.50 $n = 59$
Cheek plates	0-1	$\bar{x} = 0.0$ SD = 0.10 $n = 110$	0	$\bar{x} = 0.0$ SD = 0.00 $n = 30$	0	$\bar{x} = 0.0$ SD = 0.00 $n = 7$	1-4	$\bar{x} = 2.75$ SD = 0.69 $n = 64$
Vertebrae	40-42	$\bar{x} = 40.6$ SD = 0.79 $n = 7$	43-45	$\bar{x} = 43.7$ SD = 0.82 $n = 6$	40-41	$\bar{x} = 40.7$ SD = 0.52 $n = 6$	42	$\bar{x} = 42.0$ SD = 0.00 $n = 6$

length, 157-330 (206); interorbital length, 58-123 (107).

KEY TO THE SPECIES OF THE
GENUS *XENERETMUS*

- 1a. Cheek plates present, filling area between circumorbitals and elements of the lower jaw (Fig. 14)
..... *Xeneretmus (Xeneretmus) triacanthus*, p. 36
- 1b. Cheek plates absent, or rarely represented by a single plate that does not fill the area between the circumorbitals and elements of the lower jaw (Fig. 14)
..... Subgenus *Xenopyxis* 2
- 2a. Two or more dermal plates on eyeball ... 3
- 2b. No dermal plates on eyeball
..... *Xeneretmus (Xenopyxis) leiops*, p. 35
- 3a. Two or more barbels present at posterior corner of maxilla, 16 pectoral rays
..... *Xeneretmus (Xenopyxis) ritteri*, p. 36
- 3b. One barbel present at posterior corner of maxilla, 13-15 pectoral rays
..... *Xeneretmus (Xenopyxis) latifrons*, p. 32

Subgenus *Xenopyxis* Gilbert

Xenopyxis GILBERT, 1915:345 (type-species *Xeneretmus (Xenopyxis) latifrons* Gilbert 1890, by original designation). Jordan et al. 1930:396 (elevated to generic level).

DIAGNOSIS.—Distinguished from the subgenus *Xeneretmus* by the absence of dermal plates in the cheek region (Fig. 14B), and the failure of the breast plates to abut against each other. It further differs in having higher average counts for rays in the first and second dorsal, anal, and pectoral fins (Table 3); having larger eyes (Table 4); and in general being more robust.

Xeneretmus (Xenopyxis) latifrons (Gilbert)
[Blacktip Poacher]

(Figure 15)

Xenochirus latifrons GILBERT, 1890:92 (original description, lectotype USNM 43091).

Xeneretmus latifrons GILBERT, in Jordan 1903:360 (new combination, *Xenochirus* preoccupied).

Xeneretmus (Xenopyxis) latifrons GILBERT, 1915:345 (description, key).

Xenopyxis latifrons JORDAN ET AL., 1930:396 (checklist).

MATERIAL EXAMINED.—One hundred and eighty-two specimens, 62 to 173 mm.

TABLE 4. RANGE, MEAN, AND SAMPLE SIZE FOR BODY PROPORTIONS OF SPECIES OF *Xeneretmus*.

Character	<i>X. latifrons</i>	<i>X. leiops</i>	<i>X. ritteri</i>	<i>X. triacanthus</i>
Anal length/SL	305-486 \bar{x} = 462 n = 109	434-493 \bar{x} = 457 n = 28	484-508 \bar{x} = 498 n = 7	448-510 \bar{x} = 477 n = 57
Vent length/SL	220-335 \bar{x} = 253 n = 109	224-288 \bar{x} = 244 n = 24	253-280 \bar{x} = 265 n = 7	210-255 \bar{x} = 230 n = 57
Caudal length/SL	370-447 \bar{x} = 414 n = 106	384-479 \bar{x} = 434 n = 30	380-409 \bar{x} = 393 n = 7	384-439 \bar{x} = 410 n = 56
Second dorsal length/SL	443-592 \bar{x} = 487 n = 108	446-498 \bar{x} = 464 n = 29	490-516 \bar{x} = 501 n = 7	459-500 \bar{x} = 483 n = 57
Depth at second dorsal/SL	48-72 \bar{x} = 59 n = 106	48-64 \bar{x} = 57 n = 29	58-64 \bar{x} = 61 n = 7	47-67 \bar{x} = 58 n = 55
First dorsal length/SL	258-386 \bar{x} = 307 n = 108	269-319 \bar{x} = 291 n = 30	315-335 \bar{x} = 323 n = 7	287-317 \bar{x} = 302 n = 58
Depth at first dorsal/SL	73-132 \bar{x} = 91 n = 88	72-98 \bar{x} = 85 n = 22	86-117 \bar{x} = 95 n = 7	65-109 \bar{x} = 82 n = 54
Pectoral length/SL	123-217 \bar{x} = 167 n = 104	139-205 \bar{x} = 171 n = 29	163-188 \bar{x} = 173 n = 7	151-202 \bar{x} = 175 n = 49
Pelvic length/SL	57-105 \bar{x} = 84 n = 108	56-96 \bar{x} = 77 n = 25	72-99 \bar{x} = 83 n = 7	51-94 \bar{x} = 77 n = 57
Pectoral width/SL	97-157 \bar{x} = 113 n = 102	92-151 \bar{x} = 106 n = 23	107-127 \bar{x} = 119 n = 7	95-125 \bar{x} = 109 n = 57
Head length/SL	166-241 \bar{x} = 212 n = 109	191-227 \bar{x} = 204 n = 25	231-248 \bar{x} = 238 n = 7	190-215 \bar{x} = 201 n = 57
Ventral head length/SL	80-146 \bar{x} = 121 n = 105	99-155 \bar{x} = 113 n = 30	133-151 \bar{x} = 142 n = 7	110-143 \bar{x} = 125 n = 58
Supraoccipital pore to snout length/SL	147-186 \bar{x} = 166 n = 109	150-181 \bar{x} = 163 n = 28	167-189 \bar{x} = 180 n = 7	149-171 \bar{x} = 160 n = 57
Orbit length/head length	249-476 \bar{x} = 374 n = 109	335-419 \bar{x} = 374 n = 30	334-372 \bar{x} = 358 n = 7	299-358 \bar{x} = 326 n = 61
Upper jaw length/head length	255-363 \bar{x} = 293 n = 53	234-313 \bar{x} = 280 n = 28	278-300 \bar{x} = 286 n = 7	229-283 \bar{x} = 251 n = 53
Snout length/head length	157-330 \bar{x} = 258 n = 109	230-316 \bar{x} = 284 n = 30	249-271 \bar{x} = 258 n = 7	258-301 \bar{x} = 282 n = 60
Interorbital length/head length	58-123 \bar{x} = 100 n = 107	66-96 \bar{x} = 81 n = 30	84-125 \bar{x} = 95 n = 7	71-112 \bar{x} = 89 n = 60
Caudal depth/caudal length	37-68 \bar{x} = 47 n = 95	35-48 \bar{x} = 40 n = 28	49-60 \bar{x} = 57 n = 7	39-58 \bar{x} = 45 n = 53

LECTOTYPE.—USNM 43091, 131 mm, Albatross station 2935, San Diego, California, 32°45'N, 117°23'W, 227 m.

PARALECTOTYPES.—CAS 5072, 3 (108-110 mm), Albatross station 2973, Point Conception, California, 34°20'N, 119°44'W, 124 m; USNM 46602, 8 (72-136 mm), Albatross station 2935, San Diego, California, 32°45'N, 117°23'W, 227 m; USNM 46605, 2 (110-112 mm), Albatross station 3059, Lincoln City, Oregon, 44°56'N, 124°13'W, 141 m; USNM 46608, 120 mm, Albatross station 2972, Santa Barbara, California, 34°19'N, 119°41'W, 112 m; USNM 46611, 111 mm, Albatross station 2948, Santa Cruz Island, California, 33°56'N, 119°42'W; UW 1416, 2 (109-110 mm), Albatross station 2973, Santa Barbara, California, 34°20'N, 119°44'W, 124 m.

ADDITIONAL NON-TYPE MATERIAL.—CAS 12572, 141 mm, Farallones, California, 37°43'N, 123°03'W; CAS 14282, 2 (128, 131 mm), San Pedro, California, 33°45'N, 118°11'W; CAS 26404, 2 (114, 134 mm), Port Heunene, California, 34°09'N,

119°12'W; CAS 26447, 116 mm, Gaviota, California; CAS 26554, 3 (112-113 mm), Goleta Point, California, 34°27'N, 119°50'W; CAS 26560, 4 (97-112 mm), Santa Barbara Point, California, 34°30'N, 120°00'W; CAS 26563, 4 (118-130 mm), Santa Barbara Channel, California, 34°15'N, 119°55'W; CAS 26596, 120 mm, Santa Monica, California, 33°50'N, 118°38'W; CAS 26630, 19 (62-103 mm), Point Dume, California, 34°00'N, 118°50'W; CAS 37497, 149 mm, Half Moon Bay, California, 37°10'N, 122°42'W; CAS 40310, 136 mm, Santa Cruz, California, 34°07'N, 119°42'W; CAS 47107, 4 (99-110 mm), Goleta, California, 34°27'N, 119°50'W; CAS 47110, 8 (91-128 mm), Santa Monica Bay, California, 33°58'N, 118°38'W; CAS 47111, 6 (66-108 mm), Morro Bay, California, 35°30'N, 121°15'W; CAS 47112, 156 mm, Marin County, California, NMC 65-0259, 5 (121-153 mm), Kwatna Inlet, British Columbia, 52°07'N, 127°38'W.

SU 16903, 2 (77, 95 mm), Santa Barbara Channel, Califor-

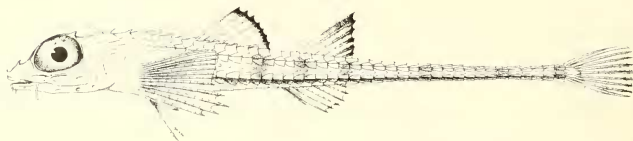


FIGURE 15. *Xeneretmus latifrons*, 142 mm SL. Courtesy of R. H. Gibbs, Jr., and the Fish Division, National Museum of Natural History.

nia, 30°26'N, 120°14'W; SU 39779, 118 mm, Santa Barbara Channel, California, 34°25'N, 120°18'W.

USNM 61176, 152 mm, Albatross station 3671, Santa Cruz, California, 37°00'N, 122°20'W; USNM 63435, 3 (70–114 mm), Point Soma, California, 32°41'N, 117°14'W; USNM 63437, 3 (82–123 mm), Point Soma, California, 32°41'N, 117°14'W.

UW 1415, 131 mm, Albatross station 3174, Bodega Bay, California, 38°16'N, 123°14'W; UW 2943, 10 (116–150 mm), Camano Island, Washington, 47°59'N, 122°13'W; UW 3151, 123 mm, Burrard Inlet, British Columbia, 49°10'N, 123°00'W; UW 3168, 4 (93–138 mm), Elliot Bay, Washington, 47°36'N, 122°22'W; UW 3907, 43 (66–142 mm), Hoodport, Washington, 47°30'N, 123°10'W; UW 4224, 12 (76–130 mm), Hood Canal, Washington, 47°17'N, 122°42'W; UW 4308, 129 mm, Hood Canal, Washington, 47°30'N, 123°10'W; UW 5780, 2 (137, 144 mm), Hoodport, Washington, 47°30'N, 123°10'W; UW 5861, 120 mm, Golden Gardens, Washington, 47°40'N, 122°24'W; UW 5872, 124 mm, Tulalip Bay, Washington; UW 5960, 132 mm, Meadow Point, Washington, 47°36'N, 122°22'W; UW 7347, 4 (104–133 mm), Puget Sound, Washington; UW 8016, 142 mm, Ballard, Washington, 47°40'N, 122°25'W; UW 18216, 5 (158–163 mm), Columbia River, 46°N, 124°W; UW 18297, 162 mm, Columbia River, 46°N, 124°W; UW 18507, 3 (162–173 mm), 46°N, 124°W; UW 20939, 146 mm, Bainbridge Island, Washington, 47°37'N, 122°33'W.

DIAGNOSIS.—Distinguished from other members of subgenus by following combination of characters: three to six spine-bearing dermal plates on each eyeball; one barb on posterior corner of maxilla; 13–15 pectoral rays (Table 5).

DESCRIPTION.—Posterior free-fold of bran-

chiostegal membrane narrow; two barbels on ventral surface of dentary, one at each posterior margin of two anteriormost acoustico-lateralis pores; breast plates surrounded by skin, and having slightly raised centers; first dorsal fin with black distal margin; second dorsal fin membrane lightly pigmented along rays, clear between rays; counts and proportions are given in Tables 3 and 4.

DISTRIBUTIONS.—Gilbert (1890) described *X. latifrons* from specimens obtained from Albatross stations situated off the coasts of California and Oregon, ranging between approximately 33° and 45°N latitude. Material examined in this study ranged from Ensenada, California to Kwana Inlet, British Columbia (Fig. 16). Gilbert (1890, 1915) reported *X. latifrons* occurred in depths from 35 to 399 m. All the lots examined for this study fell within that depth range.

COMMENTS.—In Gilbert's (1890) original description of the species, no type-specimen was designated. When the single specimen in a lot now registered as USNM 43091 was transferred to the United States National Museum by Gilbert and his associates, it was indicated in an accompanying letter that this specimen was soon to be described as the type of the species (Susan Jewett, USNM, personal communication, 7 June 1982). After examination of this specimen and the other members of the syntypic series available to me (CAS 5072, USNM 46602, USNM 46605, USNM 46608, USNM 46611 and UW 1416), USNM 43091 is hereby designated as the lectotype. This decision was reached for the following reasons: It appears to have been Gilbert's intention to designate this specimen as the type for the species, it is very close to the average for the species in the majority of characters, and its condition is as good as, if not better than, that of any other member of the syntypic series.

In comparison to its congeners, *X. latifrons* has

TABLE 5. CHARACTERS USED IN DISCRIMINATING AMONG THE SPECIES OF *Xeneretmus*.

Taxa	Characters			
	Eye-ball plates	Maxillary barbels	Cheek plates	Pectoral rays
<i>Xeneretmus latifrons</i>	3–6	1	0 or small	13–15
<i>Xeneretmus leopis</i>	0	1	0	13–15
<i>Xeneretmus ritteri</i>	3–6	2	0	16
<i>Xeneretmus triacanthus</i>	2–6	2–3	1–4	12–14

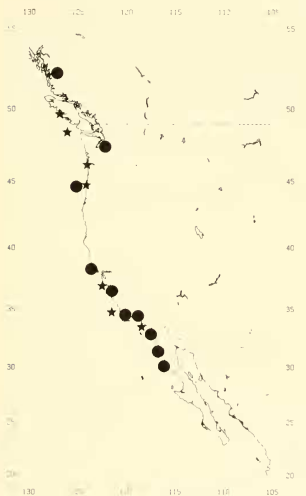


FIGURE 16. Distribution of *Xeneretmus latifrons* (circles) and *X. ritteri* (stars).

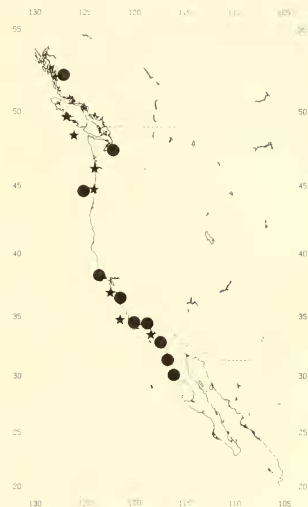


FIGURE 17. Distribution of *Xeneretmus triacanthus* (circles) and *X. leiops* (stars).

low counts for numbers of mid-ventral plates, mid-dorsal plates, infralateral plates, supralateral plates, and vertebrae; and high counts for numbers of unpaired fin rays (Table 3). Its snout is shorter, orbits longer, and interorbital distance greater than those of the other *Xeneretmus* (Table 4).

Xeneretmus (*Xenopyxis*) *leiops* (Gilbert) [Smootheye Poacher]

Xeneretmus (*Xenopyxis*) *leiops* GILBERT, 1915:348 (original description, key, illustration, holotype USNM 75813).
Xenopyxis leiops JORDAN ET AL., 1930:396 (checklist).

MATERIAL EXAMINED.—Forty-four specimens, 67–211 mm.
HOLOTYPE.—USNM 75813, 163 mm, Albatross station 4410, Catalina Island, California, 323–357 m.
PARATYPE.—SU 22988, 2 (108, 136 mm) Albatross station 4410, Catalina Island, California.

ADDITIONAL NON-TYPE MATERIAL.—LACM 93744, 5 (83–160 mm), Catalina Basin, California, 32°N, 118°W.

NMC 67-0348, 2 (147, 163 mm), Rennell Sound, British Columbia, 53°21'N, 133°04'W; NMC 72-0613 (192–211 mm), Barkley Sound, British Columbia, 48°30'N, 126°10'W.

OSU 7305, 67 mm, Newport, Oregon, 44°40'N, 124°10'W; OSU 7309, 15 (134–191 mm), Columbia River, 46°10'N, 124°05'W.

SIO 72-81, 206 mm, Neah Bay, Washington, 48°22'N, 126°10'W.

SU 3623, 7 (132–172 mm), Central California Coast, 34°45'N, 121°29'W; SU 16711, 2 (153, 165 mm), Monterey Bay, California, 36°49'N, 122°30'W; SU 26420, 3 (161–182 mm), Monterey Bay, California, 36°49'N, 122°30'W.

UW 18123, 198 mm, Columbia River, 46°N, 124°W; UW 18473, 2 (171, 179 mm), Columbia River, 46°N, 124°W.

DIAGNOSIS.—Distinguished from the other members of the subgenus by the following combination of characters: absence of dermal plates on eyeball; one barbel at posterior corner of maxilla; 13–15 pectoral rays (Table 5).

DESCRIPTION.—Posterior free-fold of branchiostegal membrane wide; breast plates thin and completely surrounded by skin; one to three barbels at posterior margin of anteriormost acoustico-lateralis pore of dentary, and one or none at posterior margin of middle acoustico-lateralis

pore of dentary; first dorsal whitish at base, black at distal margin, black pigmentation nearly reaching origin of fin, retreating distally posteriorly; second dorsal black at distal margin.

DISTRIBUTION.—Gilbert (1915) described *X. leiops* from specimens captured off Santa Catalina Island, southern California (Albatross station 4410). *Xeneretmus leiops* has a geographic distribution that ranges from Santa Catalina Island north to the Queen Charlotte Islands (Fig. 17). Specimens examined during this study were captured from depths between 183 and 357 m.

COMMENTS.—Relative to its congeners, *X. leiops* has high counts for second dorsal rays, supralateral plates, infralateral plates, mid-dorsal plates, mid-ventral plates, and vertebrae (Table 3). It also has a shorter precaudal region, longer caudal peduncle and orbits, and a smaller interorbital distance than the other members of the genus (Table 4).

Xeneretmus (*Xenopyxis*) *ritteri* (Gilbert) [Stripefin Poacher]

Xeneretmus (*Xenopyxis*) *ritteri* GILBERT, 1915:350 (original description, key, illustration, holotype USNM 75814).
Xenopyxis ritteri JORDAN ET AL., 1930:396 (listed).

MATERIAL EXAMINED.—Nine specimens, 106–141 mm.
HOLOTYPE.—USNM 75814, 123 mm, Albatross station 4366, Point Loma, California, 320–331 m.

PARATYPE.—SU 22980, 106 mm, Albatross station 4322, San Diego, California, 353–415 m.

ADDITIONAL NON-TYPE MATERIAL.—LACM 88182 2 (111, 137 mm) Gulf of California, Mexico, 29°N, 112°W.

SIO 59-92, 4 (121–141 mm), Cedros Island, Mexico, 28°23'N, 115°21'W; SIO H50-245B, 126 mm, Torrey Pines, California, 32°10'N, 117°10'W.

DIAGNOSIS.—Distinguished from the other members of the subgenus by the following combination of characters: three to six spine-bearing plates on eyeball, two barbels at posterior corner of maxilla, 16 pectoral rays (Table 5).

DESCRIPTION.—Posterior free-fold of branchiostegal membrane narrow; two barbels on ventral margin of dentary, one at posterior margin of each of two anteriormost acoustico-lateral pores; breast plates with bony prickles at centers, each surrounded by skin (such that they do not contact each other at their edges); dorsal fins with black bars along base and distal margin.

DISTRIBUTION.—Gilbert (1915) described *X. ritteri* from specimens captured near San Diego (Albatross stations 4366 and 4322). Since that time *X. ritteri* has been obtained from Cedros Island, Baja California, north to Malibu, Cali-

fornia, and in the northern section of the Gulf of California (Fig. 16). Specimens examined for this study were captured at depths from 274 to 415 m.

COMMENTS.—In comparison to its congeners, *X. ritteri* has low counts for supralateral plates, infralateral plates, mid-dorsal plates, mid-ventral plates, and vertebrae (Table 3). It also has a larger head, a longer precaudal region, and a shorter caudal peduncle than other species of *Xeneretmus* (Table 4). Its spines and ridges are more strongly developed than those of its congeners.

Subgenus *Xeneretmus* Gilbert

Xeneretmus (Gilbert) 1915:345

[Type species *Xeneretmus* (*Xeneretmus*) *triacanthus* Gilbert, 1890, by original designation.]

DIAGNOSIS.—Distinguished from the subgenus *Xenopyxis* by the presence of one to four dermal plates in the cheek region leaving little or no skin exposed in the cheek region (Fig. 14), and the tight arrangement of the breast plates. It further differs in having lower average counts for fin rays in the first and second dorsal, anal, and pectoral fins (Table 3); having larger eyes (Table 4); and in general being slender in comparison.

Xeneretmus (*Xeneretmus*) *triacanthus* (Gilbert) [Bluespotted Poacher]

Xenochirus triacanthus GILBERT, 1890:91 (original description, lectotype USNM 43089).

Xeneretmus triacanthus GILBERT, in Jordan, 1903:360 (New combination, *Xenochirus* preoccupied).

Xeneretmus (*Xeneretmus*) *triacanthus* GILBERT, 1915:345 (description, key).

MATERIAL EXAMINED.—Seventy-six specimens, 74–167 mm.
LECTOTYPE.—USNM 43089, 151 mm, Albatross station 2893, Santa Barbara Channel, California, 34°13'N, 120°33'W, 265 m.

PARALECTOTYPES.—USNM 46601, 2 (124, 154 mm), Albatross station 2893, Santa Barbara Channel, California, 34°13'N, 120°33'W, 265 m; USNM 46606, 117 mm, Albatross station 3059, Lincoln City, Oregon, 44°56'N, 124°13'W, 141 m; USNM 125577, 5 (137–152 mm), Albatross station 2973, Point Conception, California, 34°20'N, 119°44'W, 124 m.

ADDITIONAL NON-TYPE MATERIAL.—CAS 13100, 2 (78, 90 mm), San Pedro, California, 33°43'N, 118°23'W; CAS 14270, 4 (132–144 mm), Monterey Bay, California, 36°48'N, 122°07'W; CAS 26405, 134 mm, Port Hueneme, California, 34°10'N, 119°10'W; CAS 26441, 138 mm, Gaviota, California, 34°05'N, 119°02'W; CAS 47113, 2 (142, 147 mm), Point Baja, California, 30°05'N, 115°58'W.

LACM 320303, 141 mm, Bahia San Quintin, Mexico,

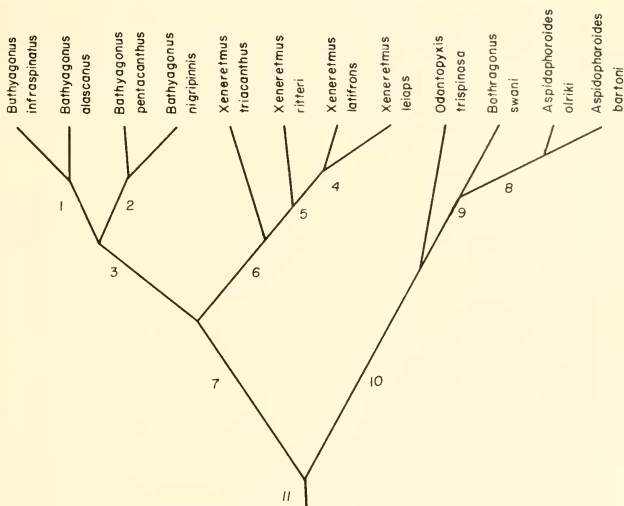


FIGURE 18. Cladogram for selected agonid taxa based on a Wagner analysis of data presented in Tables 1 and 2.

30°18'N, 115°53'W; LACM 322463, 5 (120–155 mm), Santa Monica Bay, California, 33°54'N, 118°25'W.

NMC 65-258, 147 mm, Kwatna Inlet, British Columbia, 52°25'N, 127°34'W.

SIO 51-255-56, 7 (88–151 mm), Channel Islands, California, 34°01'N, 119°24'W; SIO 6047156, 154 mm, Baja California Norte, Mexico, 31°18'N, 116°38'W; SIO 63104256, 8 (75–154 mm), Point Arguello, California, 34°10'N, 120°00'W.

SU 16712, 3 (141–142 mm), Monterey Bay, California, 36°44'N, 121°58'W; SU 19172, 104 mm, Santa Barbara Channel, California, 34°25'N, 120°06'W; SU 21363, 4 (127–148 mm), Point Pinos, California; 36°37'N, 121°55'W; SU 39780, 131 mm, Santa Barbara Island, California, 33°37'N, 119°05'W; SU 39781, 6 (105–134 mm), Santa Barbara Island, California, 34°25'N, 120°18'W.

USNM 59370, 74 mm, Albatross station 3171, Russian River, California, 38°21'N, 123°20'W; USNM 63422, 129 mm, Point Soma, California, 32°41'N, 117°16'W; USNM 63423, 122 mm, Point Pinos, California, 36°38'N, 121°56'W; USNM 63427, damaged, Santa Cruz, California, 36°58'N, 122°01'W; USNM 103719, 136 mm, Mukilteo, Washington, 47°57'N, 122°18'W.

UW 4175, 117 mm, Saratoga Passage, Washington, 47°50'N, 122°30'W; UW 4725, 4 (106–159 mm), Richmond Beach, Washington, 47°50'N, 122°30'W; UW 20948, 9 (129–167 mm), Ballard, Washington, 47°30'N, 122°30'W.

DESCRIPTION.—Two to six spine-bearing plates on eyeball; two, rarely three, barbels at posterior corner of maxilla; 12–14 pectoral rays (Table 5); branchiostegal membrane without a posterior free-fold; three barbels on ventral surface of dentary, one at each posterior margin of three acoustico-lateralis pores; dorsal fins unpigmented, blue spots present on head.

DISTRIBUTION.—Gilbert (1890) described *X. triacanthus* from specimens captured at Albatross stations located off the coasts of California and Oregon, between approximately 34° and 45° N latitude. Material examined in this study ranged from Point Baja, Baja California, north to Kwatna Inlet, British Columbia (Fig. 17). Gilbert (1915) reported *X. triacanthus* occurred in depths from 73 to 364 m; all lots examined for this study fell within that depth range.

COMMENTS.—As was the case for *X. latifrons*, Gilbert (1890) did not designate a type-species for *X. triacanthus*. When the single specimen of

TABLE 6. CHARACTER STATES, NUMBER OF EVOLUTIONARY STEPS, AND THE LOCATION OF THE EVOLUTIONARY STEPS FOR THE DATA OF TABLES 1 AND 2 ON THE CLADOGRAM ILLUSTRATED IN FIG. 18.

Character states	Number of steps	Branches where the steps take place
Spination		
Circumorbital 1 spines		
Present, absent	3	6, 9, <i>Bathyagonus nigrispinus</i>
Circumorbital 3 spines		
Present, absent	1	10
Pterotic spines		
Present, absent	2	2, <i>Xeneretmus ruteni</i>
Posttemporal spines		
Present, absent	1	7
Parietal spines		
Present, absent	1	10
Frontal spines		
Present, absent	1	9
Nasal spines		
One, two	0	—
Exposed mesethmoid spines		
Present, absent	0	—
Preopercular spines		
Present, absent	1	10
2<, ≥2	2	5, 10
Spines on rostral plate		
Present, absent	2	9, 11
5, ≠5	1	3
3, ≠3	1	<i>Xeneretmus triacanthus</i>
1, =1	2	5, <i>Odontopyxis trispinosa</i>
Spines on dermal body plates		
Present, absent	1	9
Free-fold of isthmus		
Present, absent	4	5, 8, 11, <i>Bathyagonus infraspinatus</i>
Maxillary barbels		
≤1, ≥2	2	4, 10
<3, ≥3	0	—
Exposed rostral plate		
Present, absent	1	11
Breast plates abutting		
True, false	1	5
Presence and arrangement of cheek plates		
Present, absent	2	5, 11
Abutting, not abutting	3	1, 10, <i>Aspidophoroides olrki</i>
Development of thickened fingerlike projection of ventral pectoral fin rays		
Present, absent	2	9, <i>Bathyagonus nigrispinus</i>
Slightly developed, greatly developed		
Greatly developed	2	7, <i>Bathyagonus nigrispinus</i>
First dorsal fin		
Present, absent	1	8

a lot now registered as USNM 43089 was transferred to the United States National Museum by Gilbert and his associates, it was indicated in an accompanying letter that this specimen was soon to be described as the type of the species. That lot is hereby designated the lectotype of *X. triacanthus* for the same reasons cited above (see p. 34).

PHYLETIC RELATIONSHIPS

A Wagner analysis of the binary data set (Table 2) yields Figure 18 as the most parsimonious hypothesis for the cladistic history of the agonid taxa under consideration. This cladogram requires 37 steps for the 25 characters examined. *Xeneretmus*, *Bathyagonus*, and *Aspidophoroides* are all hypothesized to be monophyletic, as is the subgenus *Xenopyxis*. *Bathyagonus* is the sister group of *Xeneretmus*; together they form the sister group of *Odontopyxis*, *Bothragonus*, and *Aspidophoroides*. The character states, the number of steps each character takes on the tree, and where the steps take place are given in Table 6.

The least derived genus *Bathyagonus*, requires only three steps from the base of the cladogram to the node that unites its members. The most derived group consists of *Bothragonus* and *Aspidophoroides*; there are eleven steps required from the root to the node that unites this group. *Xenopyxis* is intermediate between these two groups. There are eight evolutionary steps on the lineage leading from the base of the cladogram to the node that connects its three species.

Monophyly for *Xeneretmus* is evidenced by the loss of spines on circumorbital 1. This character state, however, is not unique to *Xeneretmus*; four other species also lack spines on circumorbital 1, and this loss is hypothesized to have occurred on three separate lineages (Table 6). Wagner analysis attempts to find the cladogram that best fits the entire data set. This may result in hypothesized monophyletic sets that are not supported by unique unreversed characters, as it has for *Xeneretmus*. Their existence is hypothesized because any other arrangement of the taxa would be less parsimonious.

Monophyly for the subgenus *Xenopyxis* is supported by five synapomorphies. The arrangement of the breast plates is the one unique character that unites the subgenus. These plates are separated in all members of *Xenopyxis*, whereas

they abut in all other members of the in-group and the majority of the out-group. The other four characters are not unique to *Xenopyxis*: (1) Possession of one preopercular spine is hypothesized to be a reduction from the ancestral state of two preopercular spines; a reduction in the number of preopercular spines has also occurred on the lineage leading to *Odontopyxis*, *Bothragonus*, and *Aspidophoroides*. (2) The presence of a free-fold of the branchiostegal membrane across the isthmus is hypothesized to be a reversal back to the primitive state, and one that has occurred in two other lineages, *Aspidophoroides* and *Bathragonus infraspinatus*. (3) The possession of only one spine on the rostral plate is a derived character state shared with *Odontopyxis*. (4) The absence of cheek plates is considered to be a reversal back to the primitive condition.

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